COAL AND NATURAL GAS IN THE FUTURE

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(The Important Role of Coal and Natural Gas in Vietnam)

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Abstract

Vietnam energy resource has different features in three regions of the economy: Northern, Central and Southern areas. So the high potential of hydropower and coal reserves are mainly found in the Northern area, small hydropower and diesel power generation are mainly seen in the Central area, and petroleum and gas resource seem to be rich in the Southern area.

Coal and natural gas are the important economic sectors of Vietnam. Coal and gas, at present as well as in the future will be supplied to power generation, cement industry, other industries and for services, household use.

I. present situation of coal and natural gas

I.1. Coal potential

Vietnam coal which has been exploited for over 100 years since 1883 in Dong Trieu - Quang Ninh province is one of the oldest industries in Vietnam with many different kinds, and distributed as follows:

- Anthracite coal is mainly found in Quang Ninh province, the North of Vietnam, with the reserve of about 3.5 billion tons down to the level -300m (below the sea level) and over 10 billion tons from -300m to -1000m level. Its calorific value is from 6000 to 8000 kcal/kg and the sulfur content of less than 1%.
- Lignite coal has been found in the Red River Delta with the forecasted reserve of about 36 billion tons and at deeper level (2000m) 240 billion tons with the calorific value of 5,000 to 6,000 kcal/kg, sulfur and volatile content of 5 % and 30% respectively. It is suitable for power generation.
- Peat coal is distributed in many places especially in the Cuu Long River Delta of the South Vietnam and in the North part of the economy with the reserve of about 6 billion tons this kind of coal is good for making fertilizer and household fuel.
- Fat coal is distributed in Thai Nguyen and Nghe An provinces with small reserve. The annual production is less than 100.000 tons and it is only suitable for metallurgy.

In 1999, the coal production is about 11 million tons, of which 3.2 million tons is exported 65% of coal production is exploited by open pit mining method and the rest underground mining method. After 2010, the balance in coal exploitation using the two above mentioned methods

will be achieved (50/50). After 2020, the coal production from underground mines will increase to about 70-80% of total coal production.

At the underground coal mines, the developing activities have always been carried out by using drifts and in some mines, inclined and vertical shafts. The longwall advancing on strike method is used and the specific mining technology should be used for thick and steep coal seams. Mines are mainly supported by using timber sets, metallic linings or reinforced concrete linings. At present, in some mines the hydraulic single props and hydraulic props with sliding beams are used for support.

Coal reserve, characteristic and supply for Vietnam economic sectors are shown in Table 1, 2 and 3.

I.2. Gas potential

Gas potential is concentrated in two South Con Son basins in the Southern continental shelf accounting for 40%, and Red river basin located in Northern shelf, stretching from Tonkin gulf to the Mid-central area accounting for 30%. Total gas reserve which is exploitable is over 1.200 billion m^3 of which about 1/3 has been proven. (Table 4)

Gas field reserves are at average level. Up to now, the ever-largest gas field has been discovered with hydrrocacbua volume of 75 billion m^3 but its carbonic content is very high (70-80%). The ever-biggest clean gas field with an exploitable reserve of 60 billion m^3 was discovered in the South Con Son basin. In the future, it is expected to find natural gas fields with reserve less than 32 billion m^3. Associated gas reserve of each oil field is less than 16 billion m^3.

According to evaluations, Vietnam oil exploitable reserve is around 4 billion barrels (approximately 500 million tons) in that case, average gas reserve may reach 1.200 Billion m^3 equivalent to 7,0 billion barrels (approximately 900 million tons). Therefore, it is evaluated that Vietnam gas reserve with 1.200 billion m^3 is much than oil reserve (nearly double), so Vietnam is considered a good gas potential compared to other regional economies. For example, Thailand's gas reserve is evaluated at about 980 billion m^3, Malaysia and Australia's gas reserve are 2.400 and 2.200 billion m^3 respectively. (Gas of Bachho field and Cuulong field is associated and clean gas with very low content of H_2S and CO_2 content is less than 2%. Gas of the South Conson basin is natural, clean, of low H_2S content, and CO_2 content is less than 5%).

Therefore, Vietnam has big gas and oil potential resource which can be exploited including: 780 million m^3 of oil and 160 billion m^3 of associated gas, 1.130 billion m^3 of natural gas and 200 million m^3 of condesat. The South Con Son basin, Con Son basin, Cuu Long basin, Malay-Tho Chu basin and Red River basin are main oil-gas basins which are being explored and exploited. According to recent assessment, there is about 90% of total oil and gas reserve in the above basins. Total natural gas reserve is many times bigger than associated gas reserve, it occupies approximately 90% of the total gas reserve. By 2010, it is forecasted to discover 80% of associated gas reserve and 60% of natural gas reserve. Total exploitable gas reserve is approximately 720 billion m^3, including 625 billion m^3 of natural gas and 95 billion m^3 of associated gas. The exploitation potential of the four basins: Cuu Long, the south Con Son, Malay-Tho Chu and Song Hong is high, it can reach 30 billion m^3 per year by 2010, especially the two basins Cuu Long and South Con Son of about 15 billion m^3. Based on the forecast for domestic market demand and export, Vietnam has three alternatives of supply as belows:

- Low case: about 5 billion m^3 per year (domestic market)
- Average case: about 7 billion m^3 per year (domestic market)
- High case: more than 17 billion m^3 per year (including export)

II. The important role of Coal and Gas in Vietnam energy balance

II. I. Present situation of power generation

According to the Master Plan of Power Generation Development, in the coming years, the power sector must be developed rapidly to meet the demand of the economy. Power generation capacity was 24 billion kWh in 1999. By 2001, power generation capacity is expected to reach 28 - 33 billion kWh and double after each 5 year period (about 53 billion kWh in 2005 and 80 billion kWh in 2010).

At the great demand of the economy, the power sector needs to develop all kinds of power generation such as hydropower, coal-fired power, oil-fired power, new and renewable forms of energy and more important is gas-fired power plants. At present, the main electric energy resource is hydropower (sharing 63% of installed capacity) due to the distribution of natural resource in different regions. The main fuel source for thermal power is coal in the North with the coalfield in Quangninh province. Therefore, development of coal-fired power plants in other regions is limited. Oil-fired power and small hydropower are major in the Central and the South of the economy. However, hydropower construction needs long-time and large investment. This power source structure has many disadvantages; for example, hydropower is only operated in maximum capacity in rainy season, so shortage of power becomes a serious problem in dry season. However, hydro- power tariff is the lowest, which is suitable for present situation of power consumption.

At present, projects on hydropower of Yaly, Ham Thuan-Da My, Son La are being built actively, Pha Lai coal-fired plant is being expanded with capacity of 600MW. VINACOAL has projected a new coal-fired power plant with capacity of 300 MW in Cam Pha, another with capacity of 100 MW in Na Duong and Cao Ngan of 100MW. While gas-fired power plants are considered especially important as to their period of construction.

Existing power plants in Vietnam are shown in Table 5.

II. 2. The role of coal

In the 1990s, the "open door" policy of the Vietnam government was commenced. The Vietnam economy has been stabilized step by step and has got significant advances. So there is an increasing demand on coal for domestic use and export. The power generation sector and cement industry is the major coal consumers in the economy. The growth rate of power generation, cement and fertilizer was 26.0%, 10.0% and 7.0% in 1999, respectively. Besides the coal demand for construction materials and household reached 25.0%. The coal demand in Vietnam is still very low considering the pupulation of 75 million; the average coal supply is 80 kg –100 kg per person per year. Since 1989 the coal export has been increasing: coal export reached 3.6 million tons in 1997, it was the highest rate in long time of coal exploitation in Vietnam.

In 1999 and 2000, coal export reached 3.2 million tons and Vietnam coal was exported to Japan, Western Euroup, Thailand, Philippines, Singapore, Taiwan, China, South Africa, Western Europe and Australia.

According to the Master plan of coal industry development, annual coal production was expected to increase from 6 million tons in 1994 to 11 million tons in 2000. Coal forecast for different national economic sectors is shown in Table 6.

Some coal-fired power plants, such as Uong Bi, Ninh Binh and Pha Lai plant are planned to be rehabilitated and expanded. A new coal-fired plant will be built with capacity of 600MW in Quang Ninh (2002-2006), Cao Ngan of 100 MW (2001), Na Duong (in Lang Son province) of 100MW (2001) and a power plant with capacity of 600 MW in Hai Phong city. The existing and newly built coal-fired power generation plants are shown in Table 7.

- **Cement sector**

Cement production is planned about 13,5 million tons in 2000

Over 50 vertical kilns in many localities and the Chonfong cement joint-venture plant in Hai Phong city, the Van Xa joint-venture plant in Thua Thien Hue province and the Cat Lai cement station in the South turned out 3.3 million tons of cement every year.

To meet the growing demand, the Vietnam Cement Corporation has accelerated construction work with the most recently completed project being the But Son cement plant with capacity of 1.4 million tons in the Red river delta in Ha Nam province. This plant was started in 1999.

Cement production will be increased rapidly from 13.5 million tons in 2000 and will reach 30 and 40 million tons in 2005 and 2010, respectively.

According to information from the cement industry, production of construction material as brick will also be increased. The demand for coal by the cement and construction material industry will be increased as follows: 3.70, 5.40, 7.85, 8.35 and 8.85 million tons in 2000, 2005, 2010, 2015 and 2020 respectively.

- **Other sectors**

Beside the major consumers as noted above, a coal demand by other consumers such as heavy industry, light industry, household fuel and mountain areas are at small rate, annual growth is not high. The coal demand is projected at level of about 1.6 - 1.8 million tons per year. As fuel for the rural area, coal use will be increased when the use of the traditional biomass fuel reduces by the national policy of forest closure.

II. 3. The role of natural gas

In Vietnam, according to the Master Plan of Power Development approved by Government and to the thermal power projects which have been and are being built, the demand of gas turbine power generation is 11,1 billion kWh, which shares out approximately 37% of the total power generation demand with required gas volume of 3.0 - 3.5 billion m^3 in 2000 and will be 28.1 billion kwh, which shares out 32.2% of the total power generation demand with required gas volume of approximately 7.0 - 8.0 billion m^3 in 2010. Gas-fired power projects which have been determined in the Master Plan of Power Development for period of 2000 - 2005 are Phu My 4 and Nhon Trach plants.

- **Demand for fertilizer production**

Vietnam is an agricultural economy so the demand for fertilizer is high, particularly nitrogenous fertilizer. In 2000, nitrogenous fertilizer consumption was about 5 million tons, only 6% of them were produced in the economy (from coal). Although there are many limitations in nitrogenous fertilizer production industry from coal, but it can still maintain for a period because Vietnam has many coal sources with low price. On the other hand, with great gas potential, Vietnamese government has a plan for nitrogenous fertilizer production development to take initiative of ensuring supply of fertilizer for agriculture. At the end of 2000, two gas-fired nitrogenous fertilizer plants in the South and the Central will be built with capacity of 800,000 tons per year each. These two plants will need about 0.6 billion-m3 gas per year. After 2005, expected capacity of these two plants will be doubled, making total gas demand in 2005 be 1.2 billion m^3 and 2.4 billion m^3 gas in 2020.

Gas demand for steel production

A steel production plant with capacity of 1 million tons per year will be built in Thach Khe area of the North Vietnam and will be operated at the end of 2001 with demand of 0.5 billion-m3 gas. The gas demand of this steel plant will be 1.0 billion m^3 per year.

- **Gas demand for industrial zones, household and services**

Industrial areas have great gas demand and gas will be supplied through gas pipeline system form South Conson basin directly to Ba Ria-Vung Tau area, Dong Nai area, Ho Chi Minh City. In the future, big gas reserve in Thai Binh province can supply gas to Ha Noi, Hai Phong and Nam Dinh. With the above orientation, experts have estimated that the gas demand for centralized industrial zones and household uses are 1.42 billion m^3 in 2000, 3.73 billion m^3 in 2005 and 4.86 billion m^3 in 2010.

In 2000, Petro Vietnam exploited over 9.25 million tons of crude oil; 8.59 million m^3 associated gas and produced 137.000 tons LPG.

Gas demand supply for gas-fired power generation plants in 2010 and gas demand forecast for other industrial sectors are shown in the Table No. 8 and No. 9.

The energy demand forecast of Vietnam by basic scenario is 26 billion kWh, 70.5 billion kWh and 167 billion kWh in 2000, 2010 and 2020, respectively.

Coal demands are 7.4 million tons, 10.4 million tons and 17 million tons in 2000, 2010 and 2020, respectively. In there, coal demand for power generation is 5 million tons, 8.8 million tons and 13.4 million tons in 2000, 2010 and 2020, respectively. Coal demand in 2020 is 17 million tons in case of nuclear power. If no nuclear power, the coal demand in 2020 will be reached 30 million tons. While coal demand for power generation will be 18 million tons, natural gas for power generation is 17 billion m^3 (for the power production of 85 billion kWh). In that case, Vietnam wills not need to build nuclear power, to import coal and power generation.

III. Conclusion

Coal and natural gas play an important role in Vietnam energy balance. In coming years, there are many challenges for Vietnam coal and natural gas sectors to develop these two natural resources to meet the demand of energy supply for economy economic sectors. The energy resources is economic property which has capacity to distribute an important part for rapid and long economic growth in two coming decades 2000-2020. Therefore, Vietnam government has been developing appropriate energy policies in this field in order to enhance economic benefit from coal and natural gas and to ensure National Energy Demand with lowest cost as well as friendly environment.

Table 1. Reserve of anthracite in Quangninh area (million tons)

Kind of reserve	Total reserve	Reserve of open-pit	Reserve of adit mine	Reserve of shaft mine
Calculated reserve proven	2,700.0	208.0	437.0	2,070.0
Probable reserve	800.0	7.0	33.0	765.0
Total	**3,500.0**	**215.0**	**470.0**	**2,835.0**
Possible reserve	6,500.0	-	-	6,500.0
Reserve of active mines	1,400.0	192.0	106.0	1,080.0

Source: Geology and Mineral Department.

Table 2. Some coal characteristics of Quangninh area

Parameter	Bao §ai area	Mao Khe area	Hon Gai area	Cam Pha area	Ke Bao area
Volatile content (%)	2-7	3.5-6.7	6.1-8.3	7.5-17.3	8.5-11.5
Ash content (%)	8-17	10-32	1.8-21	10-14	6-11
Sulfur content (%)	0.3-1.0	0.5-0.7	0.2-1.0	0.3-1.0	0.3-0.5
Calorific value(kcal/kg)	7,000-8.000	6,000-7,000	7,000-8,000	8,300-8.500	8,000-8,500
Gas content CH_4(m3/T)	0-5	5-10	20-25	20-30	20-30

Source: Institute of Mining Science and Technology

Table 3. Coal supply for domestic consumption in the period of 1995 - 2000 (1000 tons)

	1995	*1996*	*1997*	*1998*	*1999*	*2000*
For domestic	**4,809**	**6,075**	**7,100**	**7,805**	**6,719**	**8,328**
Power generation	1,268	1,583	2,130	2,277	1,896	2,400
Cement sector	465	609	640	559	628	3,700
Fertilizer	195	424	360	201	178	480
Paper	156	135	170	172	170	480
Others	2,723	3,323	3,300	4,596	3,847	1,268
For export	**2,836**	**3,638**	**3,600**	**2,901**	**3,235**	**3,074**
Total	**7,645**	**9,713**	**10,700**	**10,706**	**9,954**	**11,402**

Source: Annual report of VINACOAL, 1999.2000. of VIETNAM COAL REVIEWS 2001

In the 2001 (8 Months of this year) Coal supply: 8,076 (1000 tons)

- ***For Domestic: 5,316 (1000 tons)***
- ***For Export : 2,760 (1000 tons)***

Table 4. Proved reserve and gas potential (billion m^3)

No.	Basin name	Proved reserve	Potential reserve	Total
1	Hong river basin	110 - 249	142 - 415	**252 - 664**
2	Cuu Long basin	32 - 72	27 - 93	**59 - 165**
3	South Con Son basin	118 - 252	220 - 700	**338 - 952**
4	Malay-ThoChu basin	18 - 37	27 - 105	**45 - 142**
5	Other basins	-	310 - 1,000	**310 - 1,000**

Table 5. Existing power generation plants in Vietnam

No.	Plant name	Designed capacity (Mw)	Available capacity (Mw)
	Hydro power	**2,824**	**2,836**
1	Hoa Binh plant	1,920	1,920
2	Thac Ba plant	108	120
3	Da Nhim plant	160	160
4	Tri An plant	400	400
5	Thac Mo plant	150	150
6	Vinh Son plant	66	66
7	**Small hydro power**	**20**	**20**
	Coal-fired thermal power	**645**	**400**
8	Pha Lai plant	440	300
9	Uong Bi plant	105	50
10	Ninh Binh plant	100	50
	Oil thermal power FO, DO	**656**	**348**
11	Thu Duc plant	165	156
12	Tra Noc plant	33	32
13	Gas turbine Can Tho	24	10
14	Diesel Mien Nam	204	65
15	Diesel Mien Trung	230	85
	Gas -fired power plant	**281**	**281**
16	Ba Ria	264	264
17	Turbine Thai Binh	17	17
	Total	**4,484**	**3,877**

Table 6. Forecast on coal demand in national economy (million tons)

TT	Items	2001	2005	2010	2015	2020
	For domestic					
1	Power generation	2.40	4.23	4.68	4.68	4.68
2	Cement	3.70	5.44	7.85	8.35	8.85
3	Other industries	1.34	1.53	1.66	1.84	2.03
4	Household	1.00	1.20	1.50	1.50	1.50
	For export	**3.20**	**2.20**	**2.20**	**2.20**	**2.20**
	Total	**11.60**	**14.57**	**17.69**	**18.37**	**19.06**

Source: The Master Plan of The Development up to 2010 and forecast to 2020

Table 7. Existing and new coal-fired power plants

No.	Plant name	Construction time	Capacity (MW)	Total (MW)	Situation
1	Uong Bi I	1971	55 x 2	110	existing
2	Ninh Binh I	1975	25 x 4	100	existing
3	Pha Lai I	1983	110 x 4	440	existing
4	Pha Lai II	1998	300 x 2	600	new
5	Na Duong	2002	100 x 1	100	new
6	Cao Ngan	2001	100 x 1	100	new
7	Quang Ninh I	2002	300 x 1	300	new
8	Quang Ninh II	2006	300 x 1	300	new
9	Hai Phong	option	300 x 2	600	new
10	Ninh Binh II	option	100 x 1	100	new
	Total			**2,750**	

Table 8. Projects on gas-fired power plants and its gas demand to 2010 (billion m^3)

No.	Plant name	Capacity MW	Completion	1998	1999	2000	2005	2010
1	Ba Ria	327	1999	0.41	0.46	0.46	0.46	0.46
2	Phu My I	900	1999	-	0.85	0.85	0.85	0.85
3	Phu My II-1	431	1997	0.44	0.44	0.44	0.44	0.44
4	Phu My II-2	431	2001	-	-	-	0.44	0.44
5	Phu My III	620	1999	-	-	0.59	0.59	0.59
6	Phu My IV	600	2002	-	-	-	0.57	0.57
7	Nhon Trach	1,200	2005	-	-	-	0.50	1.20
8	Thu §uc	165 - 200	2001	-	-	-	0.30	0.30
9	Independent power plants	500	1998 - 2005	-	-	-	0.40	0.60
10	Thai Binh	600	2000	-	-	0.40	0.60	0.60
11	Other power plants	3,000	2006 - 2010				-	2.40
	Total	**8,974**		**0.85**	**1.75**	**2.74**	**5.15**	**8.55**

Table 9. Gas forecast for other industry sectors (billion m^3)

No.	Industrial sectors	1995	1999	2000	2003	2005	2010
1	Fertilizer	-	0.40	0.60	1.00	1.20	1.60
2	Oil chemical	-	0.40	0.60	-	1.60	2.10
3	Steel	-	-	-	0.60	0.60	0.60
4	Industrial zone	0.40	-	0,70		1.30	2.60
5	Service	-	-	0.05		0.50	0.30
6	Transportation			0.05		0.10	0.20
7	Household (Ton)			0.20		0.45	0.90
8	LPG		0.30	0.60	0.70	0.90	1.20
	Total	0,4	1,10	3,70	2,30	6,65	9,50

The end